AMENDMENTS TO THE SPECIFICATION

As suggested by the Examiner, the present specification is amended to globally replace the phrase "voice recognition" with "speech recognition" throughout the specification. Additionally, two sentences were added to the first paragraph of the specification to provide the explanation given by the Examiner.

Beginning on page 1, line 5, please replace all of the paragraphs in the Background Section with the following respective amended paragraphs:

The present invention relates generally to medical systems, such as systems used for medical information and image handling, medical diagnostic purposes, and other purposes. More particularly, the invention relates to a technique for graphically displaying available voice commands in the speech recognition control of such medical systems. It should be noted that as the relevant art has progressed, the terms "voice recognition" and "speech recognition" are generally distinguished. The term "voce recognition" now generally denotes identification of who is speaking, while "speech recognition" (or "word recognition") generally denotes identification of what is being said.

Speech recognition, which may be implemented, for example, with voice and speech recognition software, similar software engines, and the like, has been incorporated in a variety of applications in the medical field. Such applications may include translating dictated audio into text, identifying medical terms in voice recordings, and so forth. Currently, speech recognition is increasingly being used to drive and control medical information and diagnostic systems. This increased use of speech recognition to control medical systems is due, in part, to the potential to improve clinician workflow. Systems that may benefit from speech recognition control (voice control) include, for

example, picture archival communication systems (PACS), hospital information systems (HIS), radiology department information systems (RIS), and the like. Other systems that may benefit include clinical resources of various types of modalities and analyses, such as imaging systems, electrical parameter detection devices, laboratory analyses, data input by clinicians, and so forth.

The increased use of voice control of medical systems is partly a result of the fact that control techniques employing speech recognition typically offer the clinician an ergonomic advantage over traditional non-voice graphical and textual control techniques. For example, control interfaces that make use of speech recognition may enable the user to navigate hands-free throughout the instruction and control of the medical system. This is especially beneficial, for example, for modality devices and situations where the hands are not always free, such as with ultrasound systems where the sonographer may be in the process of moving the probe around the patient and desires to change views without moving the probe from its position. In the example of information systems, such as PACS and other image handling systems, voice control offers the capability of the clinician to juggle more tasks, such as image review, reporting workflow enhancements, and so forth.

In general, voice control may improve control and clinical workflow in a variety of medical systems and situations, offering the potential to improve the speed and ease of control, as well as, advance other facets of control. A problem, however, faced by designers, manufacturers, and users of medical systems that employ voice control is the barrier of relatively low accuracy rates in speech recognition. Accuracy rates are a measure of the ability of the interface, such as a workstation or computer, to properly recognize the word or command uttered by the clinician. With undesirable accuracy rates, voice control systems often do not recognize words spoken by the clinician. In response, and to improve quality, some designers and vendors define a dictionary of words and then tune recognition and system response to those words. This is sometimes

referred to as "command and control." While this may produce better results than simple free verse, additional burden is placed upon the user to remember the words the interface recognizes. The command words are often counter-intuitive and difficult to memorize, and thus impede training and use of speech recognition systems, particularly those systems that utilize "command and control" schemes.

Vendors, in an effort to mitigate this burden, may provide the clinician with a complete list of command words the voice control system recognizes. The length of the list, however, is often prohibitive, especially for more complicated systems. In general, cheat sheets or inventories of command words frequently are cumbersome and fail to effectively inform the clinician. For example, lists delivered or communicated to the clinician as a hardcopy directory or as a listing embedded in an electronic help function, are often not user-friendly and present a distraction to the clinician. Furthermore, it may not be readily apparent to the clinician which words on a list elicit a response at any given point in the control scheme or control menu tree. As a result, clinicians may avoid use of the speech recognition control component of medical systems. In other words, confusion of the acceptable commands at given points in the control menu may discourage clinicians from taking advantage of voice control. Ultimately, clinician adoption rates of voice control are impeded and opportunities to improve clinical workflow are missed. Clinicians that may benefit from effective speech recognition control of medical systems include physicians, radiologists, surgeons, nurses, various specialists, clerical staff, insurance companies, teachers and students, and the like.

There is a need for techniques that employ speech recognition control schemes that advance accuracy rate, such as through use of "command and control" engines, but where the techniques do not require the user to remember what commands he or she can say at different points or levels in the control menu tree and that do not result in reduced clinician adoption rates. For example, there is a need for interfaces that successfully inform clinicians of the established set of control words or commands at a current point in

a menu tree of a "command and control" scheme. In other words, there is a need to provide users of speech recognition control with an effective, non-intrusive, manageable set of available voice commands he or she can use while operating the medical system at the current point or scope of the menu tree. There is a need at present for more reliable and user-friendly speech recognition control of medical information and diagnostic systems which require less user training, increase clinician utilization of speech recognition to optimize clinician workflow, and permit more complicated uses of voice control.

Beginning on page 3, line 28, please replace the first four paragraphs of the Brief Description of the Invention section with the following four amended paragraphs:

The present invention provides a novel technique that provides a front-end graphical user interface for voice interaction and for displaying a list of voice commands that can be used within a control scope currently active in a medical system. The displayed list of voice commands may be a subset of commands and may change depending on where the user is in the system. The user is presented with a quick reference guide to available commands without being overwhelmed. In one embodiment, "contextual voice cues" (CVC) provide a non-intrusive dynamic list of available commands to the user which automatically pop-up and change depending on the screen or mode the user is in. An indicator, such as a feedback light, may show whether a voice command is accepted. In general, indicia, such as text, arrows, lights, color change, highlight, other indicators, or alterations of the display, may be used to acknowledge receipt of a voice command. The technique may be utilized with medical information and diagnostic systems that intuitively take advantage of speech recognition, such as picture archival communication systems (PACS), ultrasound modalities, and so forth. Other medical systems, however, that may less-intuitively employ speech recognition may also

utilize the technique. Implementation of the technique should increase clinician adoption rates of speech recognition control and thus advance improvements in clinician workflow.

With one aspect of the invention, a method for controlling medical systems includes determining available voice commands within a medical system control scheme, graphically displaying the available voice commands, receiving one or more voice commands corresponding to one or more of the available voice commands, and implementing the one or more voice commands to control the medical system. The available voice commands may be recognizable by a speech recognition control system at a current point in a menu tree and may be graphically displayed at an interface of the medical system. The speech recognition control system may be configured for "command and control" and the available voice commands may be automatically displayed. Receipt of the one or more voice commands may be indicated, for example, producing a sound, activating a light, graphically displaying a color, graphically highlighting a displayed command, and so forth. As the user progresses in control of the medical system, the method may further include determining and graphically displaying further available commands at the interface of the medical system. Applicable medical systems may include, for example, a picture archival communication systems (PACS), hospital information systems (HIS), radiology department information systems (RIS), a magnetic resonance imaging (MRI) system, a computed tomography (CT) imaging system, an ultrasound imaging system, and so forth.

Another aspect of the invention provides a method for controlling medical systems with speech recognition control, including determining recognizable voice commands that control a medical system, displaying the recognizable voice commands at an interface of the medical system, receiving one or more voice commands corresponding to the recognizable voice commands, and executing the one or more voice commands to control the medical system. The recognizable commands may be displayed in a popup box of contextual voice cues. Additionally, the recognizable voice commands may be

recognizable at a given point in a menu tree of a voice control system of the medical system. The recognizable voice commands may be a subset of the total configured voice commands of the voice control system of the medical system. Moreover, the speech recognition control system may incorporate "command and control." The method may include indicating receipt of the one or more voice commands at the interface of the medical system, and wherein the user may acknowledge indication of the voice commands to execute the voice commands to control the medical system. Again, applicable medical systems include a picture archival communication systems (PACS), hospital information systems (HIS), radiology department information systems (RIS), a magnetic resonance imaging (MRI) system, a computed tomography (CT) imaging system, an ultrasound imaging system, and the like.

In accordance with aspects of the invention, a method for using a speech recognition control system to control a medical system may include navigating through a menu tree of a speech recognition control system of a medical system, reviewing available voice commands that are graphically displayed, speaking one or more voice commands that correspond to one or more of the available voice commands. The available voice commands may be recognizable at a current point in the menu tree, may be a subset of the total configured commands in a "command and control" speech recognition control scheme, and may be automatically displayed in a popup box of contextual voice cues. The user may verify receipt of the one or more voice commands by the speech recognition control system that controls the medical system. The user may acknowledge system receipt of a delivered voice command to initiate execution of the voice command. The user may further navigate through the menu tree of the medical system. Such medical systems may include, for example, a medical information system, a medical diagnostic system, and a medical information and diagnostic system.

On page 8 in the Brief Description of the Drawings section, please replace the first, fifth, and sixth paragraphs with the following respective amended paragraphs:

Fig. 1 is a diagrammatical overview of medical information and diagnostic systems networked within a medical institution that may employ speech recognition control in accordance with aspects of the present technique;

Fig. 5 is a block diagram of an overview of a control scheme for speech recognition control in accordance with aspects of the present technique; and

Fig. 6 is a block diagram of an overview of a user method for the speech recognition control scheme of Fig. 4 and other speech recognition control schemes employing "command and control" in accordance with aspects of the present technique

In the Detailed Description of Specific Embodiments section beginning on page 8, line 27, please replace the first three paragraphs with the following respective amended paragraphs:

Turning now to the drawings and referring initially to Fig. 1, a diagrammatical overview of medical information and diagnostic systems networked within a medical institution 10 that may employ speech recognition control in accordance with the present technique is depicted. In this example, a client 12, such as a clinician, physician, radiologist, nurse, clerk, teacher, student, and the like, may access, locally or remotely, medical information and diagnostic systems and data repositories connected to a medical facility network 14. The client 12 may access such a network 14 via an interface 16, such as a workstation or computer. A medical facility network 14 typically includes additional

interfaces and translators between the systems and repositories, as well as, processing capabilities including analysis, reporting, display and other functions. The interfaces, repositories, and processing resources may be expandable and may be physically resident at any number of locations, typically linked by dedicated or open network links. The network links may typically include computer interconnections, network connections, local area networks, virtual private networks, and so forth. It should be noted that instead of as illustrated, the systems represented in Fig. 1 which may utilize aspects of the present technique may exist independent as a stand alone system and not networked to other medical systems.

The medical information and diagnostic systems depicted in Fig. 1 may each typically be associated with at least one operator interface that may be configured to employ speech recognition control, and in particular, to utilize a "command and control" scheme. The medical systems depicted in Fig. 1, for example, may have an operator interface disposed within the medical system that provides an input station or workstation for control, a monitor for displaying data and images, and so forth. An operator interface may also exist at a junction between a medical system and the network 14, as well as, between a medical system and other internal or external data connections. Medical systems that may apply voice control with aspects of the present technique include, for example, one or more imaging systems, such as a magnetic resonance imaging (MRI) system 18, a computed tomography (CT) imaging system 20, and an ultrasound system 22. Other imaging acquisition systems 24 that may make use of voice control include, for example, x-ray imaging systems, positron emission tomography (PET) systems, mammography systems, sonography systems, infrared imaging systems, nuclear imaging systems, and the like.

Imaging resources are typically available for diagnosing medical events and conditions in both soft and hard tissue, for analyzing structures and function of specific anatomies, and in general, for screening internal body parts and tissue. The components

of an imaging system generally include some type of imager which detects signals and converts the signals to useful data. In general, image data indicative of regions of interest in a patient are created by the imager either in a conventional support, such as photographic film, or in a digital medium. In the case of analog media, such as photographic film, the hard copies produced may be subsequently digitized. Ultimately, image data may be forwarded to some type of operator interface in the medical facility network 14 for viewing, storing, and analysis. Image acquisition, processing, storing, viewing, and the like, may be controlled via speech recognition combined with embodiments of the present technique, such as incorporation of contextual voice cues.

Please replace the paragraph beginning on page 11 at line 26 with the following amended paragraph:

As previously mentioned, an ultrasound imaging system 22 may benefit from speech recognition control and aspects of the present technique. Sonography and ultrasonography techniques, such as with an ultrasound imaging system 22, generally employ high-frequency sound waves rather than ionizing or other types of radiation. The systems include a probe which is placed immediately adjacent to a patient's skin on which a gel may be disposed to facilitate transmission of the sound waves and reception of reflections. Reflections of the sound beam from tissue planes and structures with differing acoustic properties are detected and processed. Brightness levels in the resulting data are indicative of the intensity of the reflected sound waves. Ultrasound (or ultrasonography) is generally performed in real-time with a continuous display of the image on a video monitor. Freeze-frame images may be captured, such as to document views displayed during the real-time study. Ultrasonography presents certain advantages over other imaging techniques, such as the absence of ionizing radiation, the high degree of portability of the systems, and their relatively low cost. In particular, ultrasound

examinations can be performed at a bedside or in an emergency department by use of a mobile system. As with other imaging systems, results of ultrasonography may be viewed immediately, or may be stored for later viewing, transmission to remote locations, and analysis. The ultrasound modality may be especially benefited by control interfaces that make use of speech recognition and thus enable the clinician to navigate hands-free. For example, as previously mentioned, in ultrasound testing, situations arise where the hands are not always free, such as with when the sonographer is in the process of moving the probe around the patient and desires to change views without moving the probe from its position. Another example is a mobile or emergency environment where even more demanding multi-tasking is common.

Please replace the paragraph beginning on page 13 at line 18 with the following amended paragraph:

Information systems within a hospital or institution which may incorporate aspects of the present technique include, for example, picture and archival communication systems (PACS) 30, hospital information systems (HIS) 32, radiological information systems (RIS) 34, and other information systems 36, such as cardiovascular information systems (CVIS), and the like. Embodiments of the present technique may be especially helpful with a PACS 30, which is an excellent candidate for speech recognition control, in part, because of the multi-tasking nature and use of the operation and interface of a PACS 30. Image handling systems, such as a PACS 30, have increasingly become one of the focal points in a medical institution and typically permit a clinician to display a combination of patient information and multiple images in various views, for example, on one or more PACS 30 monitors. A PACS 30 typically consists of image and data acquisition, storage, and display subsystems integrated by various digital networks. A PACS 30 may be as simple as a film digitizer connected to a display workstation with a small image data base, or as complex as a total hospital image management system At either extreme, a "command and control" speech recognition control scheme that

graphically displays a non-intrusive dynamic list of recognizable voice commands may assist in the processing and review of patient data and images. Such processing and review may be conducted, for example, by an operator or clinician at a PACS 30 interface (e.g., workstation). Clinicians commonly review and page through image studies at a PACS 30 workstation. In sum, this type of review of image studies may be facilitated by a speech recognition control scheme that displays a subset of recognizable voice commands that automatically change depending on the current screen or mode

Please replace two consecutive paragraphs, the first beginning at line 21 on page 16 with the following amended two consecutive paragraphs:

An increasingly prevalent area in the medical field that may benefit from application of the technique is dictation. A traditional application of dictation has been the dictation of radiological reports, which may be transcribed into a textual form and inserted, for example, into a RIS 32. The transcription is typically manual because speech recognition transcription has yet to gain widespread acceptance due to the accuracy problems of speech recognition previously discussed. However, the control of a dictation station 38 may be conducive to a speech recognition scheme having, for example, a "command and control" setup.

Audio data is typically recorded by a clinician or radiologist through an audio input device, such as a microphone. A radiological report, for example, is dictated by the clinician or radiologists to compliment or annotate the radiological images generated by the one or more of the imaging systems previously mentioned. As will be appreciated by those skilled in the art, the radiologist in dictating a report may typically physically handle multiple images while at the same time manipulate control of the dictation station 38. A reliable voice control component incorporating portions of the present technique may

permit the clinician, such as a radiologist, to record audio "hands-free" and allow clinician, for example, while dictating to focus more on examination of images and review of other pertinent patient information. Additionally, the time required for dictation may be reduced and the clinician workflow improved. In general, a variety of data entry/analysis systems 40 may benefit, for example, from speech recognition control systems that display a quick reference guide of currently available commands.

Please replace the paragraph beginning at line 29 on page 21 with the following amended paragraph:

Fig. 5 is a block diagram of an overview of a control scheme 100 for speech recognition control that uses "command and control." Initially, the applicable medical system is active, as indicated by block 102, which may be representative of a clinician, for example, turning on the medical information and/or diagnostic system, or having navigated to some later point in the control system menu tree. Later points in the menu tree may be reached, for example, by keyboard command or voice command. With the voice control scheme 100 active within the active medical system, the voice control scheme 100 determines available voice commands (block 104). In this embodiment, the subset of voice commands that are available are graphically displayed (block 106). This display of voice commands may be automatic, or instead initiated, for example, by voice or manual entry, such as a keyboard entry. A user may then review the displayed available voice commands and speak the desired voice command corresponding to one of the available commands. Block 108 is representative of the control system receiving and recognizing voice commands uttered by the user.

Please replace the paragraph beginning at line 24 on page 22 with the following amended paragraph:

Fig. 6 is a block diagram of an overview of a user method 116 for the speech recognition control scheme of Fig. 5 and other speech recognition control schemes that may employ "command and control." Block 118 represents the user having navigated through the system, either at initial startup or at some point later in the menu tree. The user or clinician may review available commands, for example, in a popup box 72 (block 120). It should be emphasized that a particularly powerful aspect of the present technique is the dynamic nature of the list of available commands which may change depending on where the user is operating in the system. Thus, the user may only be presented with the available commands that will be accepted at that point in the menu tree. The user may speak the desired command (block 122) and verify that the system received the command (block 124). The user may further navigate (block 126) through the system and the user method 88 illustrated in Fig. 5 is repeated, or the user may abandon use of voice control (block 128). In general, the user or clinician may acknowledge that the voice control system recognized and received the intended voice command to initiate execution of the command. In particular, after the system indicates or acknowledges receipt of the command, for example, by highlighting the command, the user may then acknowledge the highlighted command, such as by speaking "okay," "accept," and the like, to permit the system to implement the command. On the other hand, the control system may be configured so that a voice command may execute without the user acknowledging that the control system received the correct command.

Lastly, on page 30, please replace the paragraph in the Abstract of the Disclosure with the following amended paragraph:

The present invention provides a novel technique designed to provide a front-end graphical user interface for voice interaction, displaying a list of voice commands that can be used within a control scope of a medical system and that change depending on where the user is in the system. The user is presented with a quick reference guide to available commands without being overwhelmed. "Contextual voice cues" (CVC) provide a non-intrusive dynamic list of available commands to the user which automatically pop-up and change depending on the screen or mode the user is in. An indicator, such as a feedback light, may show whether a voice command is accepted. The technique may be utilized with medical information and diagnostic systems such as picture archival communication systems (PACS), ultrasound modalities, and so forth. Implementation of the technique should increase clinician adoption rates of speech recognition control and thus advance improvements in clinician workflow.